

HIGH DEFINITION MATRIX DISPLAY METHOD FOR STANDARD DEFINITION TV SIGNALS

Cross Reference to Related Applications

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This is a non-provisional application which claims the benefit of provisional application serial number 60/250,181, filed November 30, 2000.

FIELD OF THE INVENTION

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The present invention relates to video signal processing, and more particularly to display of standard definition video on a high definition matrix display.

BACKGROUND OF THE INVENTION

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A 1920X1080 display utilized in a high definition television (HDTV) receiver should also be useable for standard definition video such as NTSC. A means is needed that will acceptably achieve this. In the past, HDTV sets were, and still are, CRT-based. For this type of display, the signal can be reformatted to the HDTV scan rates or the scan can be changed for the standard definition signal, or a combination of the two can be used. These last two methods are not available for matrix displays (e.g., liquid crystal or liquid crystal on silicon displays) and the reformatting scheme for HDTV scan rates may be too complicated and/or may degrade the picture in matrix displays.

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The present invention is directed to facilitating the display of standard definition video on a matrix display utilized by a HDTV receiver without significantly degrading the picture in matrix displays.

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SUMMARY OF THE INVENTION

In a first embodiment of the present invention, a high definition matrix display or a 1080 line display, such as a liquid crystal display (LCD) or a liquid crystal on silicon (LCOS) display, is driven with a standard definition television signal (NTSC signal) by first deinterlacing the video and then placing the resulting progressive line signal (preferably in the form of 480 lines or a 480p signal) in a portion of the display by writing the signal into a memory. Each line of the progressive line signal is read twice from memory to produce a predetermined number of active lines of video (preferably in the form of a standard 960p signal). When the black lines at the top and bottom of the picture are transmitted, there is a shorter time to transmit the predetermined number of active lines to the display. In order to compensate for the reduced transmission time, the progressive line signal (480 active lines) are read out (twice) from the memory in a shorter time than was used to write the 480 active lines into the memory.

In an alternative embodiment of the present invention, a high definition matrix display or a 1080 line display, such as an LCD or LCOS display, is driven with an NTSC signal by first deinterlacing the video, then repeating each line, and then placing the resulting progressive line signal (preferably 960 active lines) in a portion of the display by writing the signal into a memory. When transmitting black lines at the top and bottom of the picture there is a shorter time to transmit the active lines to the display, so the active lines are read out of the memory in a shorter time than was used to write the active lines into the memory.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 illustrates an exemplary 1920X1080 display;

FIG. 2 is a flow chart illustrating the initial steps of an NTSC video signal
5 processing method in accordance with the present invention;

FIG. 3 is a flow chart illustrating a method for processing the NTSC video signal for display on the high definition matrix display in accordance with the present invention; and

FIG. 4 is a flow chart illustrating an alternative method for processing the NTSC video signal for display on the high definition matrix display in accordance with the present invention.

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The characteristics and advantages of the present invention will become more apparent from the following description, given by way of example.

Referring to FIG. 1, an exemplary high definition matrix display 10 such as a 1920X1080 display is illustrated. The display preferably includes 1080 rows with each row having 1920 pixels. The top 60 rows and bottom 60 rows preferably display black pixels and the middle 960 rows display active video. The display is preferably a matrix display such as an LCD or LCOS display.

Referring now to FIG. 2, a method 20 is shown where a received NTSC video signal is received at block 22 and is preferably sampled at block 24 at a sampling frequency that produces 1920 samples per line (corresponding to the number of pixels on a row) or a sub-multiple thereof (e.g., 960). The resulting digital video is deinterlaced at block 26 to a progressive line signal such as a 480 progressive line signal or frame (480p). Afterwards, the 480p signal may be processed in accordance with processing method A (FIG. 3) or B (FIG. 4) such that the received NTSC signal can be displayed on the HDTV matrix display.

Referring now to the processing method 30 of FIG. 3, the progressive line signal or 480p signal is written into a memory at block 32. Afterwards, at block 34, black lines are transmitted for the top 60 lines of the display. Next, the memory is read out at a speed that is fast enough to get the stored lines out in a shortened vertical interval which is preferably at about 88% of the vertical interval. The vertical interval should be understood herein to mean the amount of time it takes to display all the rows of a high definition matrix display for a given progressive line signal. Since only 480 lines were stored, each line must be repeated and transmitted twice to produce the required 960 lines. The memory is utilized because the 960 lines are formed in a normal NTSC vertical active interval (i.e., 91.4% of the period).

Referring now to the alternative processing method 40 of FIG. 4, each line of the 480p signal is repeated (used twice) to form a signal corresponding to a predetermined number of active lines such as a 960p standard definition signal at block 42. The 960p signal is then written into a memory at block 44. Next, at block 46, the memory is read out at a speed that is fast enough to get the stored lines out

at about 88% of the vertical interval. The shorter interval compensates for the transmission of black lines transmitted at the top and bottom of the display. The memory is utilized because the 960 lines are formed in a normal NTSC vertical active interval (i.e., 91.4% of the period).

5 It should be noted that the embodiments of FIGs. 3 and 4 do not necessarily require much processing in the display or special customization in a conventional high definition matrix display.

Although the present invention has been described in conjunction with the
embodiments disclosed herein, it should be understood that the foregoing
10 description is intended to illustrate and not limit the scope of the invention as
defined by the claims.

Figure 1. The effect of the concentration of the *Agaricus bisporus* spores on the growth of *Agaricus bisporus* on the substrate. The concentration of the spores was 10⁴ spores/ml (a), 10⁵ spores/ml (b), 10⁶ spores/ml (c), 10⁷ spores/ml (d), 10⁸ spores/ml (e), 10⁹ spores/ml (f), 10¹⁰ spores/ml (g), 10¹¹ spores/ml (h), 10¹² spores/ml (i), 10¹³ spores/ml (j), 10¹⁴ spores/ml (k), 10¹⁵ spores/ml (l), 10¹⁶ spores/ml (m), 10¹⁷ spores/ml (n), 10¹⁸ spores/ml (o), 10¹⁹ spores/ml (p), 10²⁰ spores/ml (q), 10²¹ spores/ml (r), 10²² spores/ml (s), 10²³ spores/ml (t), 10²⁴ spores/ml (u), 10²⁵ spores/ml (v), 10²⁶ spores/ml (w), 10²⁷ spores/ml (x), 10²⁸ spores/ml (y), 10²⁹ spores/ml (z), 10³⁰ spores/ml (aa), 10³¹ spores/ml (ab), 10³² spores/ml (ac), 10³³ spores/ml (ad), 10³⁴ spores/ml (ae), 10³⁵ spores/ml (af), 10³⁶ spores/ml (ag), 10³⁷ spores/ml (ah), 10³⁸ spores/ml (ai), 10³⁹ spores/ml (aj), 10⁴⁰ spores/ml (ak), 10⁴¹ spores/ml (al), 10⁴² spores/ml (am), 10⁴³ spores/ml (an), 10⁴⁴ spores/ml (ao), 10⁴⁵ spores/ml (ap), 10⁴⁶ spores/ml (aq), 10⁴⁷ spores/ml (ar), 10⁴⁸ spores/ml (as), 10⁴⁹ spores/ml (at), 10⁵⁰ spores/ml (au), 10⁵¹ spores/ml (av), 10⁵² spores/ml (aw), 10⁵³ spores/ml (ax), 10⁵⁴ spores/ml (ay), 10⁵⁵ spores/ml (az), 10⁵⁶ spores/ml (ba), 10⁵⁷ spores/ml (bb), 10⁵⁸ spores/ml (bc), 10⁵⁹ spores/ml (bd), 10⁶⁰ spores/ml (be), 10⁶¹ spores/ml (bf), 10⁶² spores/ml (bg), 10⁶³ spores/ml (bh), 10⁶⁴ spores/ml (bi), 10⁶⁵ spores/ml (bj), 10⁶⁶ spores/ml (bk), 10⁶⁷ spores/ml (bl), 10⁶⁸ spores/ml (bm), 10⁶⁹ spores/ml (bn), 10⁷⁰ spores/ml (bo), 10⁷¹ spores/ml (bp), 10⁷² spores/ml (bq), 10⁷³ spores/ml (br), 10⁷⁴ spores/ml (bs), 10⁷⁵ spores/ml (bt), 10⁷⁶ spores/ml (bu), 10⁷⁷ spores/ml (bv), 10⁷⁸ spores/ml (bw), 10⁷⁹ spores/ml (bx), 10⁸⁰ spores/ml (by), 10⁸¹ spores/ml (bz), 10⁸² spores/ml (ca), 10⁸³ spores/ml (cb), 10⁸⁴ spores/ml (cc), 10⁸⁵ spores/ml (cd), 10⁸⁶ spores/ml (ce), 10⁸⁷ spores/ml (cf), 10⁸⁸ spores/ml (cg), 10⁸⁹ spores/ml (ch), 10⁹⁰ spores/ml (ci), 10⁹¹ spores/ml (cj), 10⁹² spores/ml (ck), 10⁹³ spores/ml (cl), 10⁹⁴ spores/ml (cm), 10⁹⁵ spores/ml (cn), 10⁹⁶ spores/ml (co), 10⁹⁷ spores/ml (cp), 10⁹⁸ spores/ml (cq), 10⁹⁹ spores/ml (cr), 10¹⁰⁰ spores/ml (cs), 10¹⁰¹ spores/ml (ct), 10¹⁰² spores/ml (cu), 10¹⁰³ spores/ml (cv), 10¹⁰⁴ spores/ml (cw), 10¹⁰⁵ spores/ml (cx), 10¹⁰⁶ spores/ml (cy), 10¹⁰⁷ spores/ml (cz), 10¹⁰⁸ spores/ml (da), 10¹⁰⁹ spores/ml (db), 10¹¹⁰ spores/ml (dc), 10¹¹¹ spores/ml (dd), 10¹¹² spores/ml (de), 10¹¹³ spores/ml (df), 10¹¹⁴ spores/ml (dg), 10¹¹⁵ spores/ml (dh), 10¹¹⁶ spores/ml (di), 10¹¹⁷ spores/ml (dj), 10¹¹⁸ spores/ml (dk), 10¹¹⁹ spores/ml (dl), 10¹²⁰ spores/ml (dm), 10¹²¹ spores/ml (dn), 10¹²² spores/ml (do), 10¹²³ spores/ml (dp), 10¹²⁴ spores/ml (dq), 10¹²⁵ spores/ml (dr), 10¹²⁶ spores/ml (ds), 10¹²⁷ spores/ml (dt), 10¹²⁸ spores/ml (du), 10¹²⁹ spores/ml (dv), 10¹³⁰ spores/ml (dw), 10¹³¹ spores/ml (dx), 10¹³² spores/ml (dy), 10¹³³ spores/ml (dz), 10¹³⁴ spores/ml (ea), 10¹³⁵ spores/ml (eb), 10¹³⁶ spores/ml (ec), 10¹³⁷ spores/ml (ed), 10¹³⁸ spores/ml (ee), 10¹³⁹ spores/ml (ef), 10¹⁴⁰ spores/ml (eg), 10¹⁴¹ spores/ml (eh), 10¹⁴² spores/ml (ei), 10¹⁴³ spores/ml (ej), 10¹⁴⁴ spores/ml (ek), 10¹⁴⁵ spores/ml (el), 10¹⁴⁶ spores/ml (em), 10¹⁴⁷ spores/ml (en), 10¹⁴⁸ spores/ml (eo), 10¹⁴⁹ spores/ml (ep), 10¹⁵⁰ spores/ml (eq), 10¹⁵¹ spores/ml (er), 10¹⁵² spores/ml (es), 10¹⁵³ spores/ml (et), 10¹⁵⁴ spores/ml (eu), 10¹⁵⁵ spores/ml (ev), 10¹⁵⁶ spores/ml (ew), 10¹⁵⁷ spores/ml (ex), 10¹⁵⁸ spores/ml (ey), 10¹⁵⁹ spores/ml (ez), 10¹⁶⁰ spores/ml (fa), 10¹⁶¹ spores/ml (fb), 10¹⁶² spores/ml (fc), 10¹⁶³ spores/ml (fd), 10¹⁶⁴ spores/ml (fe), 10¹⁶⁵ spores/ml (ff), 10¹⁶⁶ spores/ml (fg), 10¹⁶⁷ spores/ml (fh), 10¹⁶⁸ spores/ml (fi), 10¹⁶⁹ spores/ml (fj), 10¹⁷⁰ spores/ml (fk), 10¹⁷¹ spores/ml (fl), 10¹⁷² spores/ml (fm), 10¹⁷³ spores/ml (fn), 10¹⁷⁴ spores/ml (fo), 10¹⁷⁵ spores/ml (fp), 10¹⁷⁶ spores/ml (fq), 10¹⁷⁷ spores/ml (fr), 10¹⁷⁸ spores/ml (fs), 10¹⁷⁹ spores/ml (ft), 10¹⁸⁰ spores/ml (fu), 10¹⁸¹ spores/ml (fv), 10¹⁸² spores/ml (fw), 10¹⁸³ spores/ml (fx), 10¹⁸⁴ spores/ml (fy), 10¹⁸⁵ spores/ml (fz), 10¹⁸⁶ spores/ml (ga), 10¹⁸⁷ spores/ml (gb), 10¹⁸⁸ spores/ml (gc), 10¹⁸⁹ spores/ml (gd), 10¹⁹⁰ spores/ml (ge), 10¹⁹¹ spores/ml (gf), 10¹⁹² spores/ml (gg), 10¹⁹³ spores/ml (gh), 10¹⁹⁴ spores/ml (gi), 10¹⁹⁵ spores/ml (gj), 10¹⁹⁶ spores/ml (gk), 10¹⁹⁷ spores/ml (gl), 10¹⁹⁸ spores/ml (gm), 10¹⁹⁹ spores/ml (gn), 10²⁰⁰ spores/ml (go), 10²⁰¹ spores/ml (gp), 10²⁰² spores/ml (gq), 10²⁰³ spores/ml (gr), 10²⁰⁴ spores/ml (gs), 10²⁰⁵ spores/ml (gt), 10²⁰⁶ spores/ml (gu), 10²⁰⁷ spores/ml (gv), 10²⁰⁸ spores/ml (gw), 10²⁰⁹ spores/ml (gx), 10²¹⁰ spores/ml (gy), 10²¹¹ spores/ml (gz), 10²¹² spores/ml (ha), 10²¹³ spores/ml (hb), 10²¹⁴ spores/ml (hc), 10²¹⁵ spores/ml (hd), 10²¹⁶ spores/ml (he), 10²¹⁷ spores/ml (hf), 10²¹⁸ spores/ml (hg), 10²¹⁹ spores/ml (hh), 10²²⁰ spores/ml (hi), 10²²¹ spores/ml (hj), 10²²² spores/ml (hk), 10²²³ spores/ml (hl), 10²²⁴ spores/ml (hm), 10²²⁵ spores/ml (hn), 10²²⁶ spores/ml (ho), 10²²⁷ spores/ml (hp), 10²²⁸ spores/ml (hq), 10²²⁹ spores/ml (hr), 10²³⁰ spores/ml (hs), 10²³¹ spores/ml (ht), 10²³² spores/ml (hu), 10²³³ spores/ml (hv